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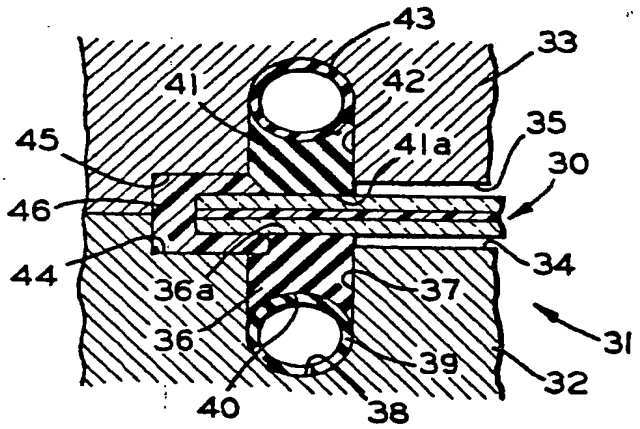
(54) Title: SEAL CONSTRUCTION FOR A MOLD STRUCTURE FOR ENCAPSULATING GLASS WITH A GASKET



(57) Abstract

A unique dynamic seal assembly for use in a mold structure for encapsulating a glass window assembly (30) with a gasket (46). A seal assembly resiliently supports the window assembly (30) and coorperates with mold structure (31) for defining a gasket forming cavity. The mold structure (31) includes two cooperating mold sections (32), (33), each of which can be provided with a groove (37), (42) for receiving a separate dynamic seal assembly. Each seal assembly includes a sealing body (36), (41) having a sealing surface (36a), (41a) which faces and sealingly contacts window assembly (30) and preferably at least one outwardly extending fin (77) formed thereon in contact with a wall of groove (37), (42). The seal assembly also includes a fluid filled bladder (39), (43) positioned between sealing body (36), (41) and cooperating mold section (32), (33). When incr ased pressure is applied to a local area of the seal as a result of a contour difference between the seal and window assembly (30), bladder (39), (43) deforms to automatically transfer at least a portion of the applied pressure to adjacent areas of the seal. Such a seal construction produces a more effective seal, produces a true gasket contour, and reduces seal fatigue, thereby increasing the life of the seal.

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Description
Seal Construction For A Mold Structure For Encapsulating Glass With A Gasket

Technical Field

The present invention relates to a seal assembly for use in an injection molding process and, more particularly, to a seal assembly for use in a mold for making encapsulated window structures.

Background Art

Initially, fixed window assemblies for vehicles were comprised of a plurality of elements including adhesive sealants applied around the marginal edges of a glass sheet, suitable mechanical fasteners such as metal clips, and exterior decorative trim strips disposed to cover the junction between the marginal edges of the glass sheet and the adjacent portions of the vehicle frame. Such window structures were costly, especially from a labor standpoint, since it was necessary to assemble the individual elements along the vehicle assembly line.

Subsequently, in an endeavor to improve the above window structure, unitary window assemblies of the type illustrated in U.S. Patent No. 4,072,340 were developed. These window assemblies included a sheet of glass, an adjacent frame, and a casing or gasket of molded material, such as polyvinylchloride, extending between the frame and the peripheral edge of the window to hold the sheet of glass and the frame together. Fasteners were provided at spaced locations along the frame such that the entire assembly could be guided into a location over the opening in a vehicle body as a unit. Other types of unitary window assemblies are disclosed in U.S. Patents Nos. 3,759,004 and 4,365,595. While such unitary window structures greatly reduce the time required to mount the window assembly in an

associated vehicle, such structures are relatively costly, since the individual components required to produce each window assembly generally must be manually assembled.

Recently, window assemblies have been formed by encapsulating at least a portion of the periphery of a sheet of glass with a gasket material. Typically, the gasket is formed by curing a polymeric gasket-forming material in situ on the glass sheet to encapsulate a predetermined portion of the marginal edge of the sheet. The gasket can be polyurethane and formed, for example, by a reaction injection molding process.

A mold structure which can be utilized to encapsulate a glass sheet with an integrally molded gasket is disclosed in U.S. Patent No. 4,561,625 issued to W. R. Weaver and assigned to the assignee of the present invention. In this patent, the mold structure includes at least two mold sections having facing surfaces cooperating to define a chamber for receiving a glass sheet. A resilient seal means is positioned in at least one of the mold sections about at least a portion of the periphery of the chamber and functions to resiliently support the glass sheet within the chamber. Each mold section includes a metallic main body portion, and the seal means maintains at least the portion of the glass sheet located inwardly of the seal means in spaced-apart relationship with the metallic main body portions of the mold sections.

Also, in the Weaver patent, the seal means cooperates with predetermined portions of the glass sheet and the mold sections for defining a gasket forming cavity having a configuration corresponding to the gasket to be formed on the glass sheet. At least a portion of the facing surfaces of the mold sections disposed outwardly of the gasket forming cavity are in metal-to-metal contact with one another. This enables the amount the seal means is compressed and the dimensions of the gasket to be controlled.

The prior art seals are typically deformable, static silicone rubber or teflon coated elastomeric seals. In order to accommodate differences in contour or edge profile which occur between individual glass sheets, these seals must be deformed sufficiently to fill "low spots" and prevent gaps between the glass and the seal which would cause excessive flash formation on the gasket being molded. This deformation causes very high pressure on the high spots, resulting in seal fatigue and leading to premature seal failure. In some instances, the excessive pressure may cause breakage of the glass sheet. In all cases excess pressure distorts the seal contour resulting in distorted molded gasket shapes.

An alternative to the use of static seals is illustrated in U.K. Patent Application 2167337A to Monnet. While the seal shown in this published application possesses certain improved characteristics, it does not provide the important advantages of the seal assembly of this invention.

Disclosure of Invention

The present invention relates to a unique seal assembly for a mold structure for molding a gasket in situ around the periphery of a glass window assembly. The seal assembly is adapted to resiliently support the window assembly within the mold structure and cooperates with the mold structure for defining a gasket forming cavity. The seal structure of the present invention is dynamic and includes a fluid filled bladder which automatically compensates for pressure differentials caused by low and high spots in the sheet of glass. With the present invention, excessive pressure generated at a high spot on the glass is transferred to an adjacent low spot to equalize the pressure along the whole length of the seal.

More specifically, the mold structure typically includes two cooperating mold sections, each of which can be provided with a groove for receiving separate dynamic seal

assemblies. Each seal assembly includes a sealing body constructed of a deformable, non-compressible material and having a sealing surface which faces and is adapted to sealingly contact the window assembly and preferably at least one outwardly extending fin formed thereon in contact with a wall of the groove. The seal assembly also includes a fluid filled bladder positioned between the sealing body and the cooperating mold section. When increased pressure is applied to a local area of the seal as a result of a contour difference between the seal and the window assembly, the bladder deforms to automatically transfer at least a portion of the applied pressure to adjacent areas of the seal. Such a seal construction produces a more effective seal and reduces seal fatigue, thereby increasing the life of the seal, and assures molding an undistorted, true to design, molded gasket.

Brief Description Of The Drawings

In the accompanying drawings:

Fig. 1 is a fragmentary sectional view of a prior art window assembly and mold structure;

Fig. 2 is a fragmentary elevational view of the prior art window assembly and seal of Fig. 1;

Fig. 3 is a fragmentary sectional view of a window assembly and mold structure incorporating a seal assembly in accordance with the present invention;

Fig. 4 is a fragmentary elevational view of the window structure and seal assembly shown in Fig. 3;

Fig. 5 is a partial schematic, partial fragmentary elevational view of a seal assembly and bladder operating system according to the present invention;

Fig. 6 is a fragmentary sectional view of a preferred embodiment of the seal assembly according to the present invention; and

Fig. 7 is a fragmentary sectional view of another embodiment of the seal assembly according to the present invention.

Modes for Carrying Out the Invention

There is shown in Fig. 1 a window assembly 10 positioned within a mold structure 11 utilizing a seal according to a prior art mold structure of the type disclosed in above-mentioned U.S. Patent No. 4,561,625, which is herein incorporated by reference. The mold structure 11 includes a lower section 12 and an upper section 13 which are coupled to suitable means (not shown) for opening and closing the mold sections 12 and 13. The mold structures 12 and 13 are typically formed of a rigid material such as, for example, steel or aluminum. Also, each of the mold sections 12 and 13 can be provided with passageways (not shown) for circulating a suitable coolant or heating fluid through the respective mold sections.

The mold sections 12 and 13 are provided with recessed portions 14 and 15 respectively in facing relationship to one another such that, when the mold sections are closed, the recessed portions 14 and 15 cooperate to define a sheet receiving or glass clearance chamber for receiving the window assembly 10 on which a gasket is to be formed. When the mold sections are open, the window assembly 10 is positioned on the lower section 12 so that the outer peripheral portion of the lower surface of the glass rests on a resilient lower seal 16 positioned within a groove 17 formed in the upper surface of the lower section 12. After the window assembly 10 is suitably positioned on the seal 16 of the lower mold section 12, the upper mold section 13 is lowered into position to enable the outer peripheral portions of the facing surfaces 18 and 19 of the cooperating mold sections 12 and 13 respectively to be clamped in

metal-to-metal contact, as shown in Fig. 1. The upper mold section 13 carries a resilient upper seal 20 positioned in a groove 21 formed opposite the groove 17. The upper seal 20 cooperates with the lower seal 16 to press yieldingly against the glass sheet window assembly 10 and resiliently support the window assembly within the glass clearance chamber.

The chamber or space between the surfaces of the recessed portions 14 and 15 is slightly larger than the thickness of the window assembly 10. However, it will be appreciated that the glass clearance chamber can be formed of any shape as long as the chamber is sufficiently large to avoid any glass-to-metal contact between the glass sheets of the window assembly 10 and the metallic mold sections 12 and 13. For example, the portions of the mold sections 12 and 13 which are below and above respectively the central portion of the glass sheet window assembly 10 can be removed such that each mold section will be generally ring-shaped. The seals 16 and 20 are preferably formed of a silicone rubber material and secured within the respective grooves 17 and 21 by means of a suitable adhesive.

In addition to resiliently supporting the window assembly 10 within the glass clearance chamber, the seals 16 and 20 cooperate with selected portions of the window assembly 10 and the mold sections 12 and 13 for defining a gasket forming cavity utilized to form a gasket 22 about the peripheral edge of the window assembly 10. More specifically, in Fig. 1, the gasket forming cavity is defined by the cooperation of a lower gasket shaping surface 23 of the lower mold section 12, an upper gasket shaping surface 24 of the upper mold section 13, portions 16a and 20a of the seals 16 and 20 respectively, and the peripheral edge portion of the window assembly 10. The gasket forming cavity can be constructed to form the gasket 22 on either the entire periphery of the window assembly 10, or on a

selected peripheral portion. Once the mold sections are closed, a flowable polymeric gasket forming material can be injected into the cavity through suitable inlet means (not shown).

Referring to Fig. 2, there is shown an elevational view of a portion of the window assembly 10 and the lower seal 16. While the seal 16 is ideally constructed with a contour which conforms to the contour of the edge of the window assembly 10, due to the normal glass forming and bending operations, the window assembly often has a contour which is slightly different from the contour of the seal 16. In Fig. 2, there is shown at 25 a difference in contour between a peripheral edge portion of the window assembly 10 and an upwardly facing portion of the seal 16. The lower surface of the window assembly 10 in the area 25 is spaced upwardly from the seal 16 when the window assembly is placed on the upper surface of the seal 16. The contour difference 25 forms a space or gap 26 which, prior to the injection of the gasket forming material, must be sealed in order to prevent leakage of the gasket forming material past the seal 16, thereby producing undesirable flash on the finished gasket.

When the upper mold section is placed on the top of the window assembly 10, pressure is applied in the direction of the arrow 27. The gasket 16 will tend to deform by compressing in the regions on either side of the gap 26 and, if enough pressure is applied, the region of the gasket 16 adjacent the contour difference area 25 will contact the facing surface of the window assembly 10 to eliminate the gap 26. However, when such contact occurs, relatively little pressure is applied to the seal 16 by the area 25 of the window assembly 10, thereby increasing the possibility of a blowout which will allow leakage of the gasket forming material and prevent fill-out resulting in an incomplete gasket. In addition, the regions of the seal 16 on either side of the gap 26 are subjected to increased pressure which

causes increased seal fatigue and results in premature seal failure. Further, if the increased pressure is excessive, breakage of the window assembly can occur.

There is shown in Figs. 3 to 7 seal assemblies according to the present invention. A window assembly 30, similar to the window assembly 10, is positioned in a mold 31 having a lower section 32 and an upper section 33. The mold sections 32 and 33 are typically formed of a metallic material and have recessed portions 34 and 35 respectively to form a chamber for receiving the window assembly 30 and preventing glass-to-metal contact between the window assembly and the mold sections. A lower seal body 36 constructed of a deformable, non-compressible material such as silicone is positioned in a groove 37 and has a sealing surface 36a which engages a lower surface of the window assembly 30 to support the window assembly above the lower section 32. The groove 37 has an upwardly facing rounded bottom wall 38 which conforms to an outside surface of a tubular bladder 39. The lower surface of the seal 36 has a downwardly facing groove 40 formed therein for accepting the tubular bladder 39.

An upper seal body 41 constructed of material similar to the lower seal body 36 is located in a groove 42 formed in the upper section 33 and has a sealing surface 41a which engages the window assembly 30. The upper surface of the upper seal 41 and the upper wall of the groove 42 are grooved and shaped to retain a tubular bladder 43. The lower section 32 and the upper section 33 have a lower cavity 44 and an upper cavity 45 respectively formed therein for forming a gasket 46 which is similar to the gasket 24.

Referring to Fig. 4, there is shown a fragmentary elevational view of the window assembly 30, the lower seal 36 and lower tubular bladder 39. A contour difference 47 in the window assembly 30 is similar to the contour difference

25 of the window assembly 10 shown in Fig. 2. However, pressure from the upper section of the mold in the direction of the arrow 48 tends to compress the bladder 39 on either side of the contour difference section 47, thereby displacing the fluid inside the bladder 39 toward the region beneath the contour difference section 47. The bladder 39 tends to expand in a region 49 to raise the lower seal 36 into contact with the lower surface of the window assembly 30 in the area of the contour difference 47. Thus, the dynamic seal according to the present invention automatically compensates for pressure differentials caused by contour differences and transfers compressive forces from "low spots" to "high spots". Therefore, the seal 36 is stressed evenly and tends to last longer and seal more reliably than the prior art seals shown in Fig. 1 and Fig. 2 and assures fill-out and undistorted gasket shape.

Typically, the upper and lower seals extend around those portions of the window periphery to which the gasket is to be molded. The associated bladder can be filled with a predetermined amount of fluid and subsequently sealed. If the gasket is to be formed around the entire periphery, the upper and lower seals in the mold will be formed as rings. The bladder under the seals will also be formed as a ring.

In instances where it is desirable to control the pressure of the fluid within a ring-shaped bladder, the interior of the bladder can be connected to a source of pressurized fluid in a manner as illustrated in Fig. 5. In Fig. 5, the bladder has spaced apart ends 60 and 61 which are connected to opposite ends of the cross portion of a "T", fitting 62. The upright portion of the "T" fitting 62 is connected to a supply line 63 which in turn is connected to a pressure fluid source 64.

A seal 65 supported by the bladder will tend to have a dead zone 66 in the unsupported area between the bladder ends 60 and 61. A bridge 67 formed from a rigid material

can be inserted in the lower surface of the seal 65 in the dead zone 66. The ends of the bridge 67 are supported by the ends of the bladder 60 and 61 and the pressure applied by the window assembly (not shown) to the seal 65 in the dead zone 66 will be evenly distributed by the bridge 67.

Many types of fluid can be utilized to inflate the bladder. For example, a relatively non-compressible liquid such as oil could be utilized to fill the bladder. If a compressible gas is utilized, the pressure fluid source could be a source of pressurized gas at a relatively higher pressure and include a pressure regulator which could be set to provide the desired pressure to the bladder. Should the molds and seals have a tendency to pose too high a pressure on the bladder, a compensator can be provided. For example, the supply line 63 can be connected to the stem of a "T" fitting 68. A cross portion of the "T" fitting 68 can have its ends connected to the pressure fluid source 64 and to a compensator 69. The compensator 69 can include a nitrogen filled bag inside a steel cylinder such that excess pressure on the gas in the bladder will tend to compress the nitrogen filled bag and reduce the pressure in the bladder.

There is shown in Fig. 6 the preferred embodiment of the present invention. In the embodiment, a seal 71 has a curved bottom surface or groove 72 which cooperates with a curved bottom surface 73 formed in a groove 74 in a mold section 75. The curved surfaces 72 and 73 conform to an outside surface of a tubular bladder 76. A first pair of fins 77 are formed on the surfaces of the seal 71 which face the side walls of the groove 74. The fins 77 are angled upwardly toward the opening of the groove and the upper surface of the mold section 75. A second pair of fins 78 are formed below the fins 77 and also are angled upwardly toward the opening of the groove 74. A third pair of fins 79 are formed at the bottom of the seal and extend in a generally horizontal direction toward the opposing side surfaces of the groove 74.

All of the fins 77, 78 and 79 contact the side walls of the groove 74 to maintain the seal 71 in the groove. The fins 77, 78 and 79 tend to prevent the gasket forming material from entering the groove 74. Thus, the tolerances of the seal 71 and the groove 74 do not have to be so precise since the fins will deflect and compensate for any differences in width. As the gasket forming material is injected under pressure, the fins on that side of the seal are placed under pressure which tends to force the fins into even better sealing contact with the walls of the groove. The higher the injection pressure the higher the sealing forces.

There is shown in Fig. 7 an alternative embodiment of the present invention. In this embodiment, a seal 81 is retained in a groove 82 formed in a mold section 83. The seal 81 has an aperture 84 formed parallel to the longitudinal axis thereof. The aperture 84 retains a tubular bladder 85. The aperture 84 is positioned near the bottom of the seal 81 such that the tubular bladder 85 functions in a manner similar to the tubular bladder 39 shown in Fig. 3. In some instances, the tubular bladder 85 may not be required as the aperture 84 can function as the bladder.

In each of the embodiments of the present invention, a seal for sealing between a window assembly and a mold section to define a gasket forming cavity includes a fluid-filled bladder means. The seal and the bladder means function together as a dynamic seal to automatically compensate for pressure differentials created by contour differences in the window assembly.

Claims

1. A seal assembly for a mold for encapsulating a window assembly, said seal assembly being received in a groove in said mold and comprising a sealing body having a sealing surface in contact with a surface of a window assembly and bladder means spaced from said sealing surface and positioned int he mold whereby when pressure is applied in a local area of said sealing surface, the pressure is transmitted through said sealing body to said bladder means which deforms to transfer at least a portion of the pressure to an adjacent area of said sealing surface, characterized in that said sealing body has at least one outwardly extending fin formed thereon in contact with a wall of said groove formed in the mold to retain said sealing body in the groove and prevent gasket forming material in the mold from flowing past said sealing body.

2. The seal assembly as claimed in claim 1, characterized in that said sealing body has at least a pair of fins formed thereon extending at an upward angle to the walls of the groove formed in the mold, said fins contacting the walls to prevent gasket forming material in the mold from flowing past said sealing body.

3. The seal assembly as claimed in either of claims 1 or 2, characterized by both a source of pressure fluid and a pressure compensator means connected to said bladder means.

4. The seal assembly as claimed in any of claims 1 to 3, characterized in that said sealing body has an aperture formed therein for retaining said bladder means.

5. The seal assembly as claimed in any of claims 1 to 3, characterized in that said sealing body has a surface opposite said sealing surface with a groove formed therein for retaining said bladder means.

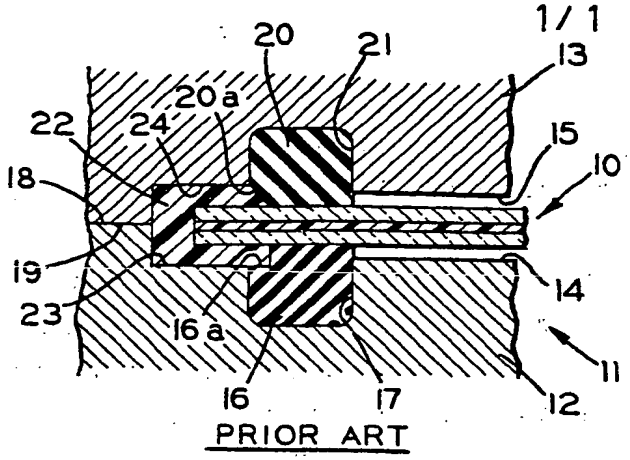
6. The seal assembly, as claimed in any of claims 1 to 5, characterized in that said sealing body is formed as a ring, and said sealing body cooperates with the mold for defining an encapsulation gasket forming cavity.

7. The seal assembly as claimed in claim 6, characterized in that said bladder means is formed as a discontinuous ring with a pair of ends connected to a source of pressure fluid and wherein said sealing body includes a rigid bridge means bridging a gap between said bladder means ends for transferring any pressure applied to said sealing surface in the area adjacent said gap to said bladder means.

8. A seal assembly for a mold for encapsulating a window assembly, said seal assembly being received in a groove in said mold and comprising a sealing body having a sealing surface in contact with a surface of a window assembly and bladder means spaced from said sealing surface and positioned in the mold whereby when pressure is applied in a local area of said sealing surface, the pressure is transmitted through said sealing body to said bladder means which deforms to transfer at least a portion of the pressure to an adjacent area of said sealing surface, characterized by a source of fluid pressure connected to said bladder means, and a pressure compensator means connected to said bladder means.

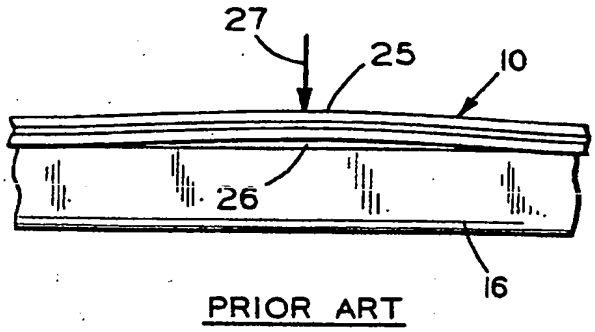
9. A seal assembly for use in a mold for encapsulating the periphery of a window assembly, the seal assembly comprising a sealing body formed as a ring and having a sealing surface in contact with a surface of a window assembly, said sealing body cooperating with a mold for defining an encapsulation gasket forming cavity, and bladder means spaced from said sealing surface and positioned in the mold whereby when pressure is applied in a local area of said sealing surface, the pressure is transmitted through said sealing body to deform said bladder means and transfer at least a portion of the pressure to an adjacent area of said sealing surface, characterized in that said bladder means is formed as a discontinuous ring with a pair of ends connected to a source of pressure fluid and wherein said sealing body includes a rigid bridge means bridging a gap between said bladder means ends for transferring any pressure applied to said sealing surface in the area adjacent said gap to said bladder means.

10. The seal assembly substantially as described with reference to the accompanying drawings.



PRIOR ART

FIG. 1



PRIOR ART

FIG. 2

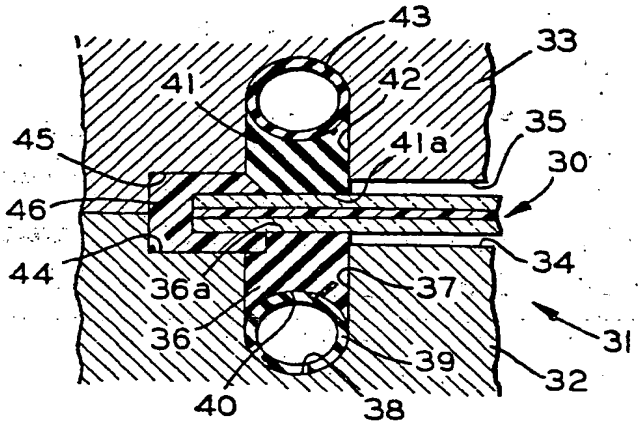


FIG. 3

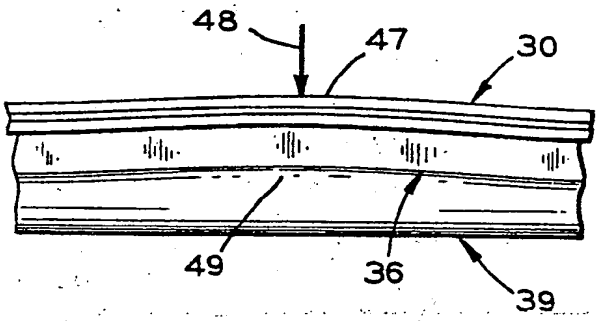


FIG. 4

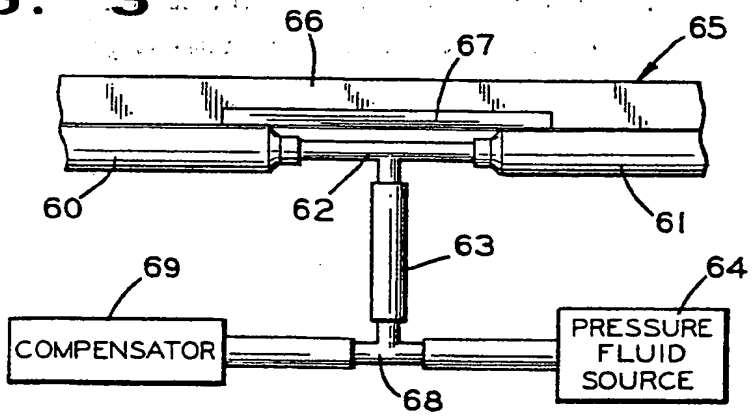


FIG. 5

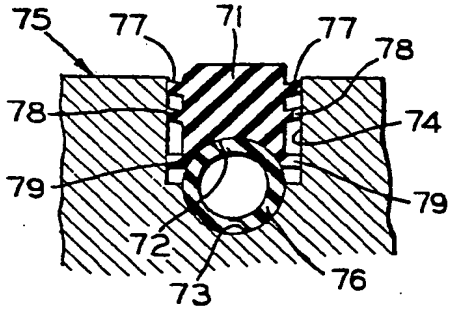


FIG. 6

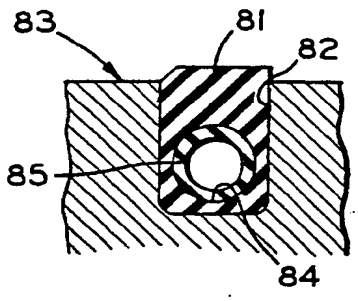


FIG. 7

INTERNATIONAL SEARCH REPORT

International Application No PCT/US87/00366

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(4): B29C 45/26

US: 249/65

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
US	249/65, 85, 95-97, 205 296/84 R 425/405 H

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

NONE

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
Y	US, A, 4,561,625 (WEAVER) 31 DECEMBER 1985.	1-10
Y	US, A, 4,133,626 (SCHUBART) 09 JANUARY 1979.	1-10
A	US, A, 2,579,072 (HARRIS) 18 DECEMBER 1951.	1
A	US, A, 2,685,118 (HUNTER) 03 AUGUST 1954.	1-10
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A	US, A, 3,513,905 (OLSON) 26 MAY 1970.	1-10
A	US, A, 3,671,349 (WESTLAKE, JR.) 20 JUNE 1972	1-10
A	US, A, 3,759,004 (KENT) 18 SEPTEMBER 1973.	1
A	US, A, 4,072,340 (MORGAN) 07 FEBRUARY 1978.	1
A	US, A, 4,323,218 (PLUM) 06 APRIL 1982.	1-10
A	US, A, 4,336,009 (WOLF) 22 JUNE 1982.	1
A	US, A, 4,364,595 (MORGAN ET AL.) 21 DECEMBER 1982.	1
A, P	US, A, 4,626,185 (MONNET) 02 DECEMBER 1986.	1-10
A	JP, A, 55-123,423 (NITTO BASEKI KK) 22 SEPTEMBER 1980.	1-10
A, P	GB, A, 2,167,337A (BILLION SA) 29 MAY 1986.	1-10

* Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
28 April 1987	15 MAY 1987
International Searching Authority [1]	**Signature of Authorized Officer [20]**
ISA/US	Robert H. Spitzer

Form PCT/ISA/210 (second sheet) (May 1986)